

QUICK LAB

Faraday Cage

TARGET SKILLS

- Hypothesizing and predicting
- Analyzing and interpreting



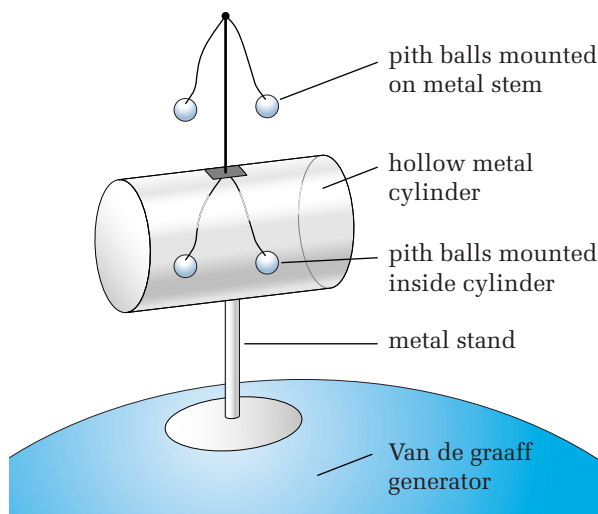
CAUTION Van de Graaff generators generate very high potential differences that might cause harm to some individuals.

You can demonstrate the shielding effect of a hollow metal cylinder by using the apparatus shown in the diagram. Either use tape to attach the metal base of the hollow cylinder-pith ball apparatus to the top of the sphere on the Van de Graaff generator, or use an electric lead to connect the two. Turn on the generator and allow it to run for a few seconds.

Analyze and Conclude

1. How does the behaviour of the pith balls inside the hollow cylinder differ from the behaviour of the pith balls mounted outside the hollow cylinder?

2. What does this experiment demonstrate about the electric field inside a hollow conductor?



Coaxial Cable

When electromagnetic waves, such as television signals, are transmitted to the home, either through or beyond the atmosphere, they are captured by a receiver (antenna) and then delivered to your television as an electric signal.

Early antenna cables consisted of a flat, twin-lead wire, with two braided wires (through which the signal was conducted) mounted in a flat, plastic insulating band. This type of wire has become less common, as it is very susceptible to interference from unwanted electromagnetic signals, such as those arising from sunspot activity, lightning storms, or even just local extraneous transmissions, such as those from power tools.

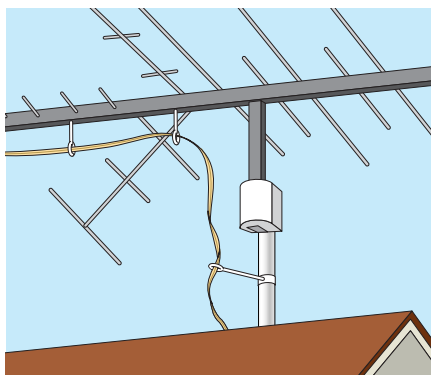
An improvement on the twin-lead wire was the shielded twin lead, in which the braided wires were each wrapped in foam insulation. The pair of wires was then wrapped in foil sheathing to provide shielding and then in an outer layer of plastic insulation.

The most efficient and popular signal-conducting wire today is the coaxial cable, consisting of concentric rings: an inner conducting wire, sometimes stranded (stereo) but usually solid

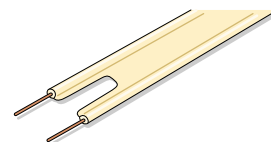
(television), a sheath of foam insulation, a second sheath of braided (or solid foil) conducting wire, and an outer sheath of plastic insulation. The actual mathematics and physics of the transport of a signal along a coaxial cable is quite complex, but for the purposes of this section, it is sufficient to say that the two wires transporting the signal are the inner core wire and the outer braided wire. The latter provides a form of Faraday shielding from external interference.

• Conceptual Problems

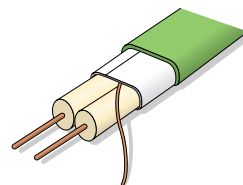
- When twin-lead wire is used to carry the television signal from the antenna to a television receiver, the directions require that the lead be twisted and not installed straight. What would be the purpose of this instruction?
- Why must the twin-lead wire be held away from the metal antenna mast, using insulating clamps?
- A homeowner knew some physics and decided to run a coaxial cable through the house inside the metal heating ducts.
 - (a) What would be one advantage of this procedure?
 - (b) State one disadvantage of this method.
- Before the advent of transistors, old superheterodyne “wireless” receivers used “radio valves” in the amplification circuit. Why were these valves often enclosed in metal cylinders?
- When transistors became the basic component of electric circuits, did they also need shielding? Research your answer.



A a flat twin-lead wire



B shielded twin-lead wire



C coaxial cable

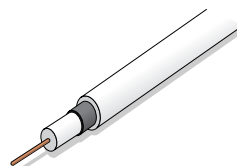


Figure 8.9 Common types of signal conducting wires.

8.2 Section Review

1. **K/U** What evidence supports the practice of enclosing electronic components in metal shells?
2. **MC** Some people who felt that TV antennas looked unsightly hid them in the attics of their houses. Discuss how the type of roof and siding material has relevance to this practice.
3. **MC** Some people feel that it is relatively safe to take shelter in a car during a lightning storm, because the rubber tires will provide insulation. However, a lightning strike that has travelled several kilometres is not going to be discouraged from jumping the last few centimetres. In what way does a car offer protection from lightning?